Computer Program Descriptions

Planar Network Analysis Programs— PNAP1 and PNAP2

PURPOSE: To compute the admittance matrices of planar microwave networks as a function of frequency by the finite element method.

LANGUAGE: Fortran IV (IBM). Source decks plus test data together consist of 1519 cards for the two programs. Compilation time is 13 s for PNAP1 (IBM Fortran IV G1 compiler, IBM 360/75 computer) and 2 s for PNAP2. PNAP1 requires 25K words at execution; PNAP2, 8K words.

AUTHORS: P. Silvester and A. Konrad, Department of Electrical Engineering, McGill University, Montreal, H3C 3G1, Que., Canada.

AVAILABILITY: The programs are available as ASIS-NAPS Document No. NAPS-03075. Copies of the source decks may be purchased through the authors for $50 (U.S.), within two years of publication.

DESCRIPTION: In [1] the port admittance matrix of a planar network is formulated in terms of certain harmonic functions φ_i related to the port voltages and the network geometry, together with the natural modes Φ_k of the networks with all ports shorted. The necessary harmonic functions and eigenfunctions are found using a finite element technique for which general-purpose computer programs already exist [2].

PNAP1 consists of a MAIN and seven subroutines (READIN, ASSEMB, FUNCTS, PRODUC, LOCATE, ROTAT1, BLOCK1). The subroutines READIN and ASSEMB as well as LOCATE, ROTAT1, and BLOCK1 are similar to the ones used in the scalar x–y finite element programs [2]. They are used here in order to reconstruct the finite element coefficient matrices S and T. READIN reads and prints all input data used with the finite element programs.

Subroutine FUNCTS reads and prints the wavenumbers Ω_k and the approximate eigenfunctions Φ_k as well as the approximate harmonic functions φ_i (see [1]).

Subroutine PRODUC returns the products $S\varphi_i$ and $T\Phi_k$. Using these results, MAIN evaluates the right-hand sides of (37) and (38) in [1].

The program prints and punches the eigenvalues Ω_k^2 and the admittance matrices associated with each eigenfunction.

PNAP2 reads and prints the data punched out by PNAP1 and it also reads in the number of frequency steps and the upper and lower frequency limits. PNAP2 then prints out the first pole frequency and a list of frequencies and the corresponding admittance matrix elements.

The programs have been tested for two-part planar networks using fourth-order finite element approximations but can be easily dimensioned to deal with any number of ports. Execution times amount to a few seconds for each problem.

Manuscript received June 10, 1975; revised June 13, 1977.

See NAPS document No. 03075 for 58 pages of supplementary material. Order from ASIS/NAPS c/o Microfiche Publications, P.O. Box 3513, Grand Central Station, New York, NY 10017. Remit in advance for each NAPS accession number. Institutions and organizations may use purchase orders when ordering, however, there is a billing charge for this service. Make checks payable to Microfiche Publications. Photocopies are $14.50. Microfiche are $3.00. Outside of the United States and Canada, postage is $3.00 for a photocopy or $1.00 for a fiche.

References

[1] P. Silvester, "Finite element analysis of planar microwave networks," *IEEE Trans. Microwave Theory Tech.*, vol. MTT-21, pp. 104–108, Feb. 1973.

[2] A Konrad and P. Silvester, "Scalar finite-element program package for two-dimensional field problems," *IEEE Trans. Microwave Theory Tech.*, vol. MTT-19, pp. 952–954, Dec. 1971.